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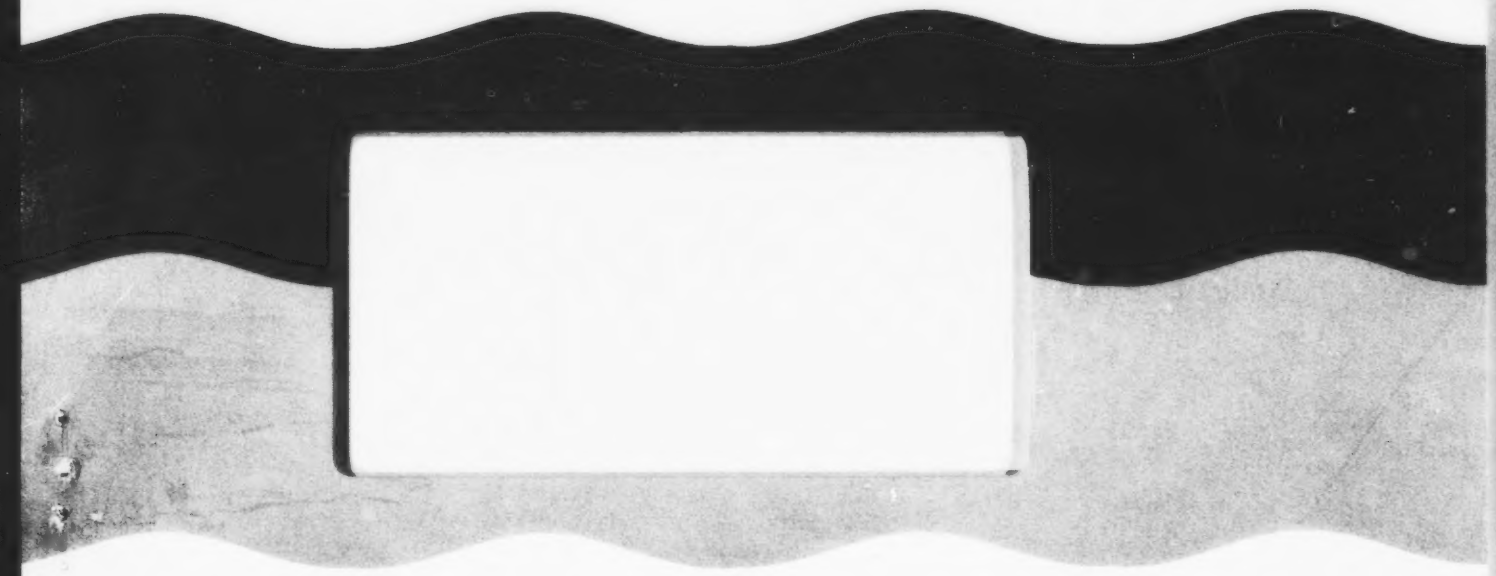

Investigation Report to the Minister pursuant to sections 542 or 545 of the Canada Shipping Act

Rapport d'investigation au Ministre conformément aux articles 542 ou 545 de la Loi sur la marine marchande du Canada

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REPORT OF INVESTIGATION INTO THE CIRCUMSTANCES ATTENDING THE CAPSIZING OF THE CANADIAN FISHING VESSEL "VIKING LEADER" IN BARKLEY SOUND, OFF VANCOUVER ISLAND, B.C., MAY 12, 1986.

REPORT No. 469

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REPORT OF INVESTIGATION INTO THE CIRCUMSTANCES ATTENDING THE CAPSIZING OF THE CANADIAN FISHING VESSEL "VIKING LEADER" IN BARKLEY SOUND, OFF VANCOUVER ISLAND, B.C., MAY 12, 1986.

Particulars of Vessel

Name	"VIKING LEADER"
Official Number	347452
Port of Registry	Nanaimo, B.C.
Call Sign	CZ 3844
Gross Tonnage Net Tonnage	63.91 19.88
Length- Overall - Registered	17.68 m 15.72 m
Breadth - Moulded	5.49 m
Depth - Moulded	2.87 m
Calculated Draught (at time of casualty)	2.81 m Fwd 3.37 m Aft
Type	Small fishing vessel, seiner/dragger, steel hull, aluminum deck-house
Built	Halliday Marine Ltd., Nanaimo, B.C. 1973
Propulsion	Caterpillar diesel, 6 cylinder Model 343, 360 b.h.p. single fixed-pitch propeller
Cargo	Bait & fishing gear only
Crew	7
Owners	Leader Fishing Ltd., Richmond, B.C. V7A 3B5

Navigating Equipment

Radar	OKI, Model ONX-6A

Echo Sounder (2)	Furuno Mark II, Model F850 Furuno Model FCV 201, Colour Display
Loran-C	Furuno, Model LC 200
Plotter	Furuno, Model FP 170
VHF (1) (2) (3)	Comdev Marine, Model CPM 255 Regency, Model M-100 Scanner Sailor, Compact Scrambler, VHF/SSB
SSB	Comdev Marine, Model INTECH, M2500
Magnetic Compass (1) (2)	Soura Keiki Seisakusho Co.Ltd. Types unknown

Lifesaving Equipment

Liferaft (1)	Beaufort inflatable 6 person, Model 'A' pack

Lifebuoys (2)
Life Jackets (9)
Immersion Suits, Asst'd (8)
EPIRB (1)

Description of Vessel

The "VIKING LEADER" was designed by a naval architect in Vancouver, B.C. and built for the Leader Fishing Company Limited, in Nanaimo, B.C. in 1973. Her hull is of welded steel construction and she has an aluminum deck-house. The deck-house, wheel-house, crew's accommodation and engine-room are located forward of amidships and the fish hold compartments and lazaret space aft of amidships.

Used principally as a herring seiner, the "VIKING LEADER" was outfitted during the early part of 1986 to participate in black cod trap fishing.

Under the requirements of the Small Fishing Vessel Inspection Regulations, the "VIKING LEADER" was subject to inspection every four years by the Ship Safety branch of the Canadian Coast Guard and her last periodic survey was performed while the vessel was in drydock at West Bay, Delta, B.C., on July 8, 1985.

She was certificated as a Home Trade Class II vessel; her Inspection Certificate form SIC 29, was issued July 8, 1985 and was valid until May 31, 1986 (the inspection certificate was short-termed due to pitting of the tail end shaft forward of the propeller taper).

The "VIKING LEADER" was surveyed for insurance purposes on November 9, 1984 at which time she was described as being well maintained.

Note:

1. All times in this report are expressed in Pacific Daylight Saving Time (UTC minus 7 hours).

2. A glossary of abbreviations and terms can be found following the Findings of this report.

Background

In the early morning of May 12, 1986, the small fishing vessel "VIKING LEADER" departed from Ucluelet, B.C., to take part in the second black cod fishery opening of the 1986 season.

That same morning whilst en route to the fishing grounds in good weather conditions, the vessel developed a starboard list and within minutes lay over on her starboard side and capsized.

The crew abandoned the vessel in a liferaft and were rescued shortly afterwards by the fish dragger "ROYAL CANADIAN" which was in the immediate vicinity.

The "VIKING LEADER" did not sink and was righted some days later and towed to Vancouver, B.C. where she underwent a refit, and subsequent stability tests.

There were no serious injuries as a result of this casualty nor was there any appreciable amount of pollution reported.

The "VIKING LEADER" re-entered service on July 26, 1986 to participate in the salmon fishery. The cost of salvage and refurbishment of the vessel was in the order of $340,000.

Note: The "PACIFIC LEADER", also owned by the same company, had left Steveston, B.C., March 16, 1986 for Barkley Canyon, west of Vancouver Island, to engage in the previous black cod trap fishery. Whilst en route to

the grounds and at the western entrance to Juan de Fuca Strait, she capsized and sank in good weather and sea conditions with the loss of two of her seven crew members on March 17, 1986. (Report #432 refers).

Narrative

The "VIKING LEADER" departed from Steveston, B.C., March 16, 1986 and participated in the first black cod fishery opening of the 1986 season from March 17 to April 21. During this period, the vessel fished at Barkley Canyon, off the west coast of Vancouver Island and called into Ucluelet approximately every five days to land her catch. At the close of the first opening, the "VIKING LEADER" was laid up in Ucluelet and her crew proceeded on leave.

The crew re-joined the "VIKING LEADER" between May 6 and May 8, 1986, and the next few days were spent fitting out the vessel for the second black cod fishery opening which was due to commence at 1300, May 12. The fitting out included repairing and loading fish traps, loading bait and provisioning.

On May 11, with all loading completed, fish traps on deck were well lashed down with polypropylene rope and hatches and manholes to the fish hold and the lazaret space were secured and double-checked. When ready for sea, the "VIKING LEADER" had 275 black cod fish traps lashed on deck in stacks of 25; 2.5 strings of 2.2 cm diameter polypropylene line on the seine net drum, and 2,721 kg of assorted bait in pens and brailers on deck. Both the port and starboard fish tanks were full to capacity with sea water, the middle hold was full with 2.5 additional strings of ground line and some spare line and the after hold, which was penned off into three sections, had a further 1,540 kg of bait stowed between the port and starboard sides.

The "VIKING LEADER" did not carry a full load of fuel on departing; she carried approximately 4,900 litres of diesel fuel in her after wing tanks and some residue, estimated at 227 litres in her forward tanks. The vessel's fresh water tank contained approximately 4,500 litres.

In the early morning of May 12, a final check was made to ensure the "VIKING LEADER" was properly secured for sea, then, at 0230, she departed from her berth with a crew of seven on board including the master, bound for the fishing grounds in Barkley Canyon.

Once clear of the dock, the vessel idled slowly out of

the harbour while the port and starboard outrigger poles were rigged and swung outboard in the raised position after which, some crew members, having completed their duties, retired to their quarters.

The "VIKING LEADER" developed a slight starboard list when clear of the dock and this was attributed to the fixed black cod fishing gear.

At 0330, when clear of the Carolina Channel light and whistle buoy No.'Y42', the "VIKING LEADER" was set on a southerly course on the magnetic compass, for Barkley Canyon and the automatic steering was engaged.

Although the vessel had a service speed of approximately 10 knots at 1850 rpm, the engine was set at about 1600-1650 rpm, to give a speed of approximately 8 knots in order to arrive at the fishing grounds in time for the fishery opening commencing at 1300.

Once clear of buoy 'Y42', roll dampening paravanes (stabilizer fins) were deployed from the outrigger poles, and the vessel proceeded in a comfortable manner with only a slight roll. The master remained on watch in the wheel-house accompanied by the engineer who, although off watch, chose to remain in the wheel-house; all other crew members retired to their quarters.

Weather conditions existing at the time were overcast and raining, with:

Wind	South-easterly, 10-15 knots
Sea state	0.3 metre chop
Swell	Low, 0.9-1.2 metres
Visibility	Poor, in rain and mist

The "VIKING LEADER" sailed with approximately 25 cm of freeboard amidships and was taking on seas amounting to some 10-12 cm of sea water washing over her after deck. The vessel's freeing ports were all clear and open to allow the sea water free access to drain off the decks. After passing buoy 'Y42', the engineer checked the decks at intervals of approximately 30 minutes and found everything to be in order.

At approximately 0445, the "VIKING LEADER" passed two fish draggers and about 10 minutes later, she began listing over to starboard. Being extremely concerned, the master sent the engineer, once again, to check the afterdeck while he slowed the engine down to an idling speed. On sighting the afterdeck, the engineer immediately notified the master that seas were coming over the starboard bulwarks and advised that

he should alert the crew.

All crew members were awakened and cleared out of the forecastle and other sleeping areas. They proceeded out through the after galley door and climbed the ladder to the flying bridge where their immersion suits and the liferaft were stowed. At this time the starboard outrigger pole which had been raised to an angle of approximately 45°, was now touching the water.

One crew member attempted to return to the galley to collect the EPIRB stowed there; however, the water on deck had risen too high and he could not open the galley door. It was reported that at this time all hatches and manholes remained secured and the bait remained in its stowed position on deck.

The master, in the meantime having glanced out the after galley/pantry door, realized from the amount of water on the afterdeck, that the vessel was listing faster since he had slowed her down. He therefore increased speed and attempted a turn to port. These actions however, were to no avail as the vessel continued listing. He then put the engine into neutral and shortly after, water began coming over the starboard bulwarks forward of the wheel-house.

At 0506, May 12, 1986, in position 48°46'52"N, 125°39'43"W, the master broadcast a 'MAYDAY' message on the VHF radiotelephone, channel 16, and gave the position of the "VIKING LEADER". At this time the vessel was almost lying over on her starboard beam ends and water was entering the starboard wheel-house door, downflooding into the forecastle head, galley and engine-room spaces and smoke was pouring from the galley stove.

The master had no time to wait for an answer to his 'MAYDAY' message. He made a quick search for his immersion suit which was the only one stowed in the wheel-house but it had been displaced from its stowed position as a result of the list and flooding. With no time to even shut off the engine, he climbed on top of the steering wheel shaft to reach for the port wheel-house door and two seamen opened the door and pulled him out.

Meanwhile, the crew had donned their immersion suits and prepared and inflated the liferaft. The liferaft was launched over the port side, clear of all rigging.

At approximately 0507, May 12, the crew abandoned the "VIKING LEADER" by making their way along the ship's side to the keel and boarding the liferaft from there. They cut the

liferaft clear of the vessel and remained in the vicinity while they fired off distress rockets and flares. The "VIKING LEADER" continued to list until she was completely capsized.

The distress call from the "VIKING LEADER" was received at Tofino Coast Guard Radio Station (CGRS) and they immediately informed Rescue Coordination Centre (RCC) Victoria and issued an All Stations 'MAYDAY' relay broadcast at 0507. Tofino Vessel Traffic Services (VTS) also intercepted the distress call and were later to assist Tofino CGRS by supplying radar vectoring information to assist rescue vessels in locating the "VIKING LEADER".

Several vessels responded to the 'MAYDAY' broadcast including the fishing vessels "ROYAL CANADIAN" and "SEA CREST" and the American registered freighter "PHILADELPHIA". RCC also alerted and tasked primary Search and Rescue (SAR) resources in the area and requested helicopter assistance from the American Coast Guard.

The "ROYAL CANADIAN", the vessel closest to the "VIKING LEADER", sighted the distress rockets and flares at 0519 and by 0532, had all seven survivors safely on board. RCC Victoria stood down all search vessels and aircraft by 0549.

Since none of the survivors required immediate transportation ashore for medical attention, the "ROYAL CANADIAN" remained in the area awaiting more suitable conditions to place a towline on board the "VIKING LEADER".

At 1300, commercial divers contracted by the insurance underwriters for the "VIKING LEADER", secured a towline on the overturned vessel and she was towed by the "ROYAL CANADIAN" to Mayne Bay where she was secured to a mooring buoy later that same evening.

The survivors were transferred to another vessel and taken ashore to the hospital in Ucluelet at about 1600; none were detained.

At the onset of recovery operations, difficulties were encountered in the process of righting the "VIKING LEADER". Initially, there were inadequate lifting capabilities and this problem was compounded by trapped buoyancy, created by the loose ballast shifting, acting in opposition to the righting efforts. The vessel was successfully righted some days later and towed to Vancouver, B.C., where she underwent a refit and returned to service on July 2, 1986 to participate in the salmon fishery.

Analysis

1. Construction and History of Vessel

The "VIKING LEADER" was originally used as a herring packer and later as a longliner and dragger until 1981, when she was converted for use as a seiner. The conversion included dividing the fish hold into four compartments and fitting a seine net winch and power drum. Each of the four fish compartments was foam insulated and glassed, and a 'champagne' brine system installed, allowing the catch to be carried either dry, iced or in a chilled brine environment. To facilitate the use of this new equipment, the raised afterdeck at centre was altered to remove a step up in way of the seine net drum, which also reduced the capacity of the centre fuel oil tank.

Fuel oil is carried in two tanks each with a capacity of 3,010 litres, located one on each side of the engine-room; two tanks of 9,390 litres capacity, each located on each side of the lazaret space; and one centre tank of 5,720 litres capacity located forward of the lazaret space.

The fresh water tank located forward of the engine-room was common with the forepeak, giving a total fresh water capacity of 6,230 litres.

After her conversion to a herring seiner, the "VIKING LEADER" became subject to the Stability Regulations and the vessel was inclined at Surrey, B.C. on July 9, 1981.

As a result of the inclining, the vessel was fitted with permanent ballast in the form of two lengths of railway line welded to the underside of the keel, and two tons of steel punchings in the engine-room. The steel punchings were fitted to port and starboard of the engine beds to improve her stability. The stability booklet for the vessel was approved by Coast Guard Ship Safety branch on March 21, 1984.

The owner of the "VIKING LEADER" obtained a black cod fishing licence in July 1985 and during January and February 1986, the vessel was further modified in order to engage in black cod trap fishing. Black cod trap fishing entails the carriage of bait and a large number of cod traps on deck and the main cargo boom is swung out and plumbed over the starboard side during fishing operations. The modifications included fitting a pot hauler boom amidships on the starboard side; fitting

spooling gear forward of the seine drum to facilitate the handling of long lengths of ground line and fitting a working platform around the stern, to allow more work space on the afterdeck.

The underdeck space was divided by five transverse water-tight bulkheads into the following compartments: forward crew accommodation space; engine-room; forward hold, port and starboard; mid-hold; after hold; and lazaret space.

The vessel has crew accommodation in the forecastle head for four persons, the entrance is through a trap door in the wheel-house, with an emergency exit through an escape hatch in the foredeck. The remaining accommodation and galley/pantry areas are located immediately aft of the wheel-house, with exits via the port and starboard wheel-house doors and at the after end of the galley/pantry area.

2. Black Cod Fishery

The black cod fishery (also known as 'sable fish') has a very lucrative market with a relatively short season and approximately 90% of the catch is frozen and exported to Japan.

In order to maintain control over the black cod fishery, the Department of Fisheries and Oceans restricted the number of licences to 48 in 1986. The 1986 season was opened between March 17 and April 21 and again, from May 12 to June 9, 1986.

There is no regulation as to the number of traps a vessel is allowed to use when fishing for black cod. The Department of Fisheries and Oceans sets a quota on the total allowable catch for each season based on ground fish assessments made by their biological staff and a Sable Fish Advisory Committee advise on the openings. The 1986 quota was 4,000 tonnes of black cod which total includes trap fishing and longlining, the former method being considered the most successful.

The 1986 black cod season was closed about one week early due to the quota having been met.

3. Warning to Owners in the Black Cod Fishery

Because of the Canadian Coast Guard surveyors' concern at the observed condition of many of the vessels with traps carried on deck, a letter was sent November 5,

1985, from the Ship Safety branch of the Canadian Coast Guard to several companies involved in black cod fishing, including Leader Fishing Limited, drawing their attention to the possibility of their vessels operating in an unsafe departure condition because of an unrestricted above deck complement of gear and cod traps. The companies were urged to contact the Ship Safety branch office confirming that the loading conditions were within the capabilities of the vessel. There was no response in this regard from the owner of the "VIKING LEADER".

4. "VIKING LEADER" Fish Traps

The "VIKING LEADER" carried two different sizes of black cod fish traps: both were frustum shaped, with one type weighing 22.68 kg, and the other, which was a new type, weighing 26.30 kg.

The "VIKING LEADER" fished with 80 traps to a string between one set of flag poles. Each string consisted of approximately 3,657 metres of 2.2 cm diameter polypropylene ground line with approximately 46 metres of line between traps. There were also 731 metres of 2.2 cm diameter buoy line at each end of the string constituting a total of 5,120 metres of line to each string.

5. Stability

(a) As a small fishing vessel of more than 15 gross tons built before July 6, 1977, and not engaged in fishing for herring or capelin at the time of the casualty, the "VIKING LEADER" was not required to comply with the stability requirements of Part I, Section 29, of the Small Fishing Vessel Inspection Regulations. Regulatory approval is based upon compliance with criteria detailed in Canadian Coast Guard 'Stability, Sub-division and Load Line Standards', STAB 4. Although the "VIKING LEADER" was not required to comply with these requirements, they are considered to be the most appropriate 'yardstick' against which the stability characteristics of fishing vessels of this size may be assessed - notwithstanding the mode of fishing in which they may be employed.

The actual criteria contained in STAB 4 are listed in Annex 2 of this report and a direct comparison between the minimum values required and the results of the post-casualty stability analysis of the "VIKING LEADER" are included in Annex I, 'Stability Evaluation'.

(b) In 1986, prior to the casualty, the seine winch, net and warps were removed and the vessel refitted with black cod trap fishing gear. During post-casualty inspections of the recovered vessel, the weights and locations of the outfit of black cod fishing gear were verified and details of the cod traps, warps, bait, oil fuel and other consumables reportedly on board at the time of the capsize, were obtained from the master.

The following reported changes were made during the vessel's refit:

Moved off vessel

(i)	Seine winch from afterdeck	1,361 kg	(3,000 lbs)
(ii)	Two bulwark fairleads	204 kg	(450 lbs)
(iii)	Seine net	3,054 kg	6,730 lbs)
(iv)	Seine skiff	305 kg	(670 lbs)

Added to Vessel

(i)	Pot-hauler Pillar Starboard Side	270 kg	(595 lbs)
(ii)	Pot-hauler, Outrigger Starboard Side	186 kg	(410 lbs)
(iii)	Pot-hauler	349 kg	(770 lbs)
(iv)	Spooling Gear Fwd of Seine Drum	209 kg	(460 lbs)
(v)	Spooling Gear Roller Fairlead	102 kg	(225 lbs)
(vi)	Ground Line Frame	68 kg	(150 lbs)
(vii)	Ground Line Guide Fairlead	102 kg	(225 lbs)
(viii)	Stern Platform & Rails	204 kg	(500 lbs)
(ix)	Deck Boards under Drum	54 kg	(120 lbs)
(x)	Sundry fittings	14 kg	(30 lbs)

The reported disposition of weights on board the vessel at the time of the capsizing is listed as follows:

Oil Fuel	4.10 Tons	After tanks (P&S)
Oil Fuel	0.20 "	Engine-room (P&S)
Lub Oil	0.39 "	Engine-room (P)
Stove Oil	0.20 "	Deck-house top
Fresh Water	4.46 "	F.W.Tank & forepeak
Provisions & Stores	0.25 "	In Galley & Stores
Crew & Effects	0.60 "	

Sea Water	26.40 tons	Fwd Holds (P&S)
Bait	1.52 "	After Hold (P&S)
Bait	1.34 "	On Deck, under seine drum
Bait	1.34 "	On Deck, in way of hatch
Polypropylene 2.2 cm Line & 210 rings	3.58 "	Wound on seine drum
Polypropylene 2.2 cm Line & 160 rings	3.00 "	Stowed, mid hold
275 Black Cod Traps	6.88 "	On main deck and stern platform
Flag poles, buoys & chains, etc.	0.30 "	On main deck

(c) Measurement of the recovered vessel indicated that while the principal dimensions were satisfactory, the actual hull form differed significantly from the original designed lines, and that the forward and aft draught marks were not accurately located. Progress inspections by the designer's surveyor, representing the owner while the vessel was building, were principally focused upon materials and workmanship quality. No records have been found of why or how the modification of the designed hull form occurred while the vessel was being constructed. Because the 'as-built' and 'as-designed' hull forms were different, the original basic design data were no longer applicable, and therefore the stability characteristics submitted in the Trim and stability Booklet did not represent the actual vessel. Approval of all stability data by Canadian Coast Guard is subject to the accuracy of the basic design data submitted. This accuracy is the responsibility of the vessel's owner, his shipbuilder or naval architect.

The hull of the "VIKING LEADER" was measured in July, 1986, while she was hauled-out and being refitted after the casualty, and an 'as-built' lines plan was prepared from which her actual hydrostatic particulars and cross curves of stability were derived. Toward the end of the refit, an inclining experiment was carried out July 18, 1986, and the vessel's current lightship weight and centre of gravity were verified.

Comparison of the herring seining stability characteristics resulting from the redundant original basic design data and those derived from the 'as-built' vessel shows that both sets exceeded the minimum regulatory requirements of STAB 4. The cumulative effects of the discrepancies between the original and 'as-built' hull form, tanks and lightship characteristics were largely self-cancelling, and the end results indicating the vessel's transverse stability

derived from the redundant and actual basic data were generally similar.

A post-casualty analysis of the transverse stability characteristics of the "VIKING LEADER" was carried out which incorporated the currently established basic design data, and focused upon the detrimental effects of the additional weight, off-centre and vertical location of the black cod fishing gear, traps and warps, etc., together with the free-surface effect of the water reportedly shipped and retained on deck shortly before the capsize.

The intact stability loading condition incorporating the above and below deck deadweights and consumables reportedly on board, shows that upon departure from Ucluelet, the transverse stability characteristics of the "VIKING LEADER" were substantially below the minimum standards of STAB 4. The maximum righting lever was only 50% of the minimum requirement.

(d) Reportedly, on departure the "VIKING LEADER" had a slight list to starboard because of the off-centre location of the fixed black cod fishing gear, and post-casualty calculations show this to have been approximately 2.75°, with a corresponding freeboard of only 0.25 m (10 in.). In this loading condition, even moderate rolling of approximately 5.25° in calm seas would cause water to be shipped on to the main deck. Because the effectiveness of the freeing ports in the port and starboard bulwarks was impaired as the deck edge became immersed at the end of each roll, the shipped water was not always completely cleared and shortly before the capsize, was seen to have accumulated toward the after end of the main deck. As the quantity of water initially retained on deck was not great, a 'nominal' layer only 76 mm (3 in.) deep, 1.60 m (5.25 ft) long, and extending across the deck aft of the main hatchway, was incorporated in the post-casualty calculations and was considered to be a conservative representation of the vessel's actual condition.

The weight and free surface effect of the shipped water reduced the existing freeboard and caused a drastic deterioration of the vessel's already low stability characteristics. When the detrimental effects of the inherent heel caused by the off-centre black cod fishing gear are considered, the vessel's transverse stability deteriorates even further. In this latter condition the maximum righting lever of just 32 mm (1.25 in) was reached at 15° heel and the range of positive stability

was limited to 31.5°. These criteria represent the most likely condition immediately prior to the capsize and show that the maximum righting lever and total dynamic stability were only 15.6% and 11% respectively, of the minimum standards required by STAB 4.

(e) Figure 1 graphically illustrates the relative levels of transverse dynamic stability of the vessel upon departure from Ucluelet and shortly before the capsize, and compares them with the minimum requirements of STAB 4.

(f) In general, few fishermen fully understand free surface effect and fewer appreciate the substantial loss of transverse stability when water, even a few inches, is shipped and retained on deck. Coupled with the loss of effective water plane area when the deck edge is submerged, the effects can be disastrous.

(g) It should be noted that these transverse stability characteristics are based upon the 'ideal' static sea state. In actual dynamic sea conditions, angles of roll are usually greater than calculated by 'static' methods, and because of the uneven effects of wave motion and ship speed, the calculated reserve dynamic stability of small vessels is subject to considerable fluctuation.

(h) It would appear that while the "VIKING LEADER" was in the highly vulnerable condition indicated by the aforementioned characteristics, the dynamic heeling effect produced by the impetus of the vessel's rolling motion in the prevailing sea state, overcame her initial ability to recover. Having been rolled toward the limiting range of positive stability, the vessel, because of the reduced righting levers, tended to remain heeled over to starboard for some time. When the angle of heel reached approximately 17° and the bulwark top rail became immersed, the sudden increase in the rate and quantity of water shipped and retained on the starboard side of the main deck retarded the vessel's recovery. The increasing angle of heel led to further water being shipped, and at this time the coaming of the door on the starboard side of the wheel-house was submerged. The subsequent downflooding into the forward compartments below the main deck effectively prevented the vessel's return to the upright, it continued until positive transverse stability was lost and the "VIKING LEADER" capsized.

The final momentum of the capsize was such that when the "VIKING LEADER" heeled toward and passed 90°, the two tons of unsecured steel punchings serving as permanent

ballast were dislodged from the engine-room bilges, and the volume of air entrapped in the engine-room and the other empty compartments was sufficient to ensure the vessel remained afloat. When the "VIKING LEADER" was completely capsized, the dislodged ballast, having fallen to the engine-room 'deckhead', contributed to the inverted initial statical stability, helped maintain the vessel in the inverted position, and facilitated her later recovery.

6. Freeing Ports

Three freeing ports measuring 420 mm x 290 mm (16 1/2 in. x 11 1/2 in.), and nine measuring 406 mm x 76 mm (16 in. x 3 in.), were incorporated in each of the 762 mm (30 in.) high, port and starboard bulwarks, giving a total area of 0.643 m^2 (6.94 ft^2) on each side of the vessel. The freeing ports were all arranged on the weather deck within a well, approximately 10.2 m (33 ft 6 in.) long, extending from the after end of the forecastle deck to the break of the raised afterdeck.

Based upon a well length of 10.21 m (33 ft 6 in.), the Small Fishing Vessel Inspection Regulations, para 29.1 (1) requires a minimum freeing port area of approximately 1.0 m^2 (10.76 ft^2) on each side of the vessel. The reduced area of the actual freeing ports in conjunction with the low heeled freeboard, contributed to the rate and extent of accumulation of the water reportedly retained on deck just prior to the casualty.

7. Outrigger Paravane Operation

The towing of submerged delta-shaped paravane devices suspended from outrigger booms to port and starboard in order to reduce the amplitude of a vessel's roll, is now a common and established practice on west coast fishing vessels. Few problems have been reported and experience has shown the effectiveness of the practice but it is not without risk. The safe functioning of the submerged delta-shaped plates is largely dependent on the towing speed and their complementary operation to port and starboard, such that the righting moment caused by the downward force generated on one side is synchronized with the upward roll of the vessel on that same side.

If the port and starboard synchronization is disturbed or lost, an athwartship moment can be applied to the vessel when she is rolling towards the paravane generating the most downward force, and the vessel's roll may actually be increased on that side. The syn-

chronous and complementary operation would be eliminated if a paravane were lost or the boom and rigging on one side were to fail, and would be significantly disturbed if one paravane surfaced or became fouled with floating kelp, abandoned nets, submerged debris or obstructions on the seabed.

A previously reported capsizing of a fishing vessel, caused by the failure of one stabilizer to correctly operate, was immediate and dramatic. The described capsize of the "VIKING LEADER" followed the more familiar pattern of a 'slow roll over', typical of a vessel with inadequate stability.

8. Mechanical Equipment

Engines were tested prior to departure and it was reported that both the engines and steering gear were operating in a satisfactory manner.

9. Main Cargo Hatch

The main hatch cover was of aluminum alloy construction and was fitted with a gasket which fitted snugly onto the raised hatch coaming; on departure, the cover was lashed to the deck. A small portable cover was incorporated into the main cover to provide easy access to the mid hold.

Access Hatches

Manholes to the lazaret space and to the starboard fish tank were of an approved design: flush with the deck, of aluminum alloy construction with a cross-bar locking device and key operated on the outside.

The manhole access to the port fish tank, also flush with the deck, was fitted with a portable alloy raised fish feeder which was secured to the deck by two turnbuckles. The flush manhole access to the bait hold was fitted with a portable alloy hatch coaming device also secured to the deck by two turnbuckles.

All hatches and manholes were secured prior to sailing.

10. Divers' Report

On May 13, 1986, after the "VIKING LEADER" was towed to Mayne Bay, an underwater inspection revealed that the after bait hold access cover was missing along with 125 black cod traps.

It would appear that the cover and traps became dislodged during the towing operation as all crew members testified that prior to sailing from Ucluelet, all covers were double checked and found to be secure; they were also observed to be intact just prior to the abandoning of the vessel.

11. Water Level Alarms

The "VIKING LEADER" was equipped with water level alarms in the lazaret space, the shaft tunnel and in the engine-room.

It was reported that no alarms were heard until after downflooding commenced. It was also reported that all compartments were inspected and found to be dry prior to sailing. The lazaret space, which could not be accessed due to gear stowed on the manhole, was pumped dry.

12. Engine-room Pumps

The vessel was equipped with the following pumps:

Fire/Bilge pump	Viking, 76 mm diameter rotary pump capable of drawing from all watertight spaces i.e. lazaret, engine-room, bait hold, fish holds and accommodation.
Fire/Bilge pump	Monarch, 38 mm diameter auxiliary powered rotary pump.

Circumstance did not allow time for the pumps to be utilized.

13. Weather

The casualty occurred in the West Coast Vancouver Island marine forecast area and the forecasts issued by Environment Canada for May 11th, 12th and 13th, were as follows:

(i) Issued at 2345 May 11, 1986 and valid until 2400 May 12th:

West Coast Vancouver Island

Gale warning continued for northern sections.
Northern section.
Winds southerly 15 to 25 knots increasing to south-east 30 to gales 40 overnight.
Southern section.
Winds south-east 10 to 20 knots increasing to south-east 20 to 30 early Monday morning. Showers changing to rain Monday. Visibilities lowering to 2 miles in precipitation.
Outlook. Strong to gale force south-easterlies.

(ii) Issued at 0545 May 12, 1986 and valid until 0600 May 13, 1986:

West Coast Vancouver Island

Gale warning continued for northern sections.
Northern section.
Winds southerly 25 knots to gales 35 becoming west to south-west 20 to 30 this evening.
Southern section.
Winds southerly 20 to 30 knots becoming west to south-westerly 15 to 25 knots overnight. Intermittent rain today. Showers thereafter. Visibilities lowering to 2 miles in precipitation.
Outlook. Strong to gale force south-westerlies.

The weather reported by the local light Stations at 0500 May 12, 1986 was as follows:

Amphitrite	Overcast, light drizzle and fog Wind, southerly 18 knots Height of sea- unknown Barometer 1017.3 mb and falling
Cape Beale	Overcast, rain Wind, south-easterly 22 knots and gusting Sea- 4 feet, Swell, moderate to low south-westerly

14. Lifesaving Equipment

The Small Fishing Vessel Inspection Regulations made pursuant to the Canada Shipping Act state in part, in section 30 under the heading 'Life Saving Equipment':

(4) Every fishing vessel exceeding 12.2 m in length shall carry

(c) in the case of a vessel the keel of which was laid on or after January 6, 1965,

(i) a boat, dory or skiff capable of accommodating not less than four persons;

(ii) an inflatable life raft of sufficient capacity to accommodate

(A) 50 percent of the persons on board, or

(B) if the vessel makes voyages other than inland voyages and goes beyond the limits of Home Trade, Class III voyages, 75 percent of the persons on board, and

(iii) if the equipment required by sub-paragraphs (i) and (ii) is not capable of accommodating 1 1/2 times the number of persons on board, such additional boats, dories, skiffs or inflatable life rafts as are necessary to provide accommodation in the aggregate for 1 1/2 times the number of persons on board; and....

At the time of the casualty there were seven crew members on board the "VIKING LEADER": four were berthed in the forecastle accommodation, two in the deck-house accommodation, and one additional crew member was berthed in the pantry area.

It was reported that the vessel operated with seven crew members only when engaged in black cod fishing due to the extra work involved.

The "VIKING LEADER" did not carry a boat, dory or skiff, she carried only a 6 person inflatable liferaft. The vessel normally carried a 9 person seine skiff, however due to the nature of black cod trap fishing requiring considerable deck space and the fact that the seine skiff was not needed in the fishing operation, it was not carried. The vessel had 8 immersion suits on board.

15. Certification

The master of the "VIKING LEADER" holds a valid 350 ton, Master Home Trade Certificate of Competency. He has 28 years sea-going experience of which two years were on tugs and the remainder on fishing vessels. He has sailed on the "VIKING LEADER" since her maiden voyage and has been master on board her for the past 8 years.

The Canada Shipping Act does not require a fishing vessel of less than 100 gross tons to carry certificated officers and hence the "VIKING LEADER" did not require a certificated master.

The engineer on the "VIKING LEADER" does not hold a Certificate of Competency nor is he required to. He has 24 years experience on board fishing vessels of which approximately 7 years were as engineer. He first joined the "VIKING LEADER" in January 1986 and later assumed the engineer's position in May 1986.

The mate on the "VIKING LEADER" does not hold a Certificate of Competency nor is he required to. He has 10 years experience on board fishing vessels and has been on the "VIKING LEADER" for 5 years.

Of the remaining crew members, one deck-hand had 5 years experience on the "VIKING LEADER", another had 7 years fishing experience with 5 weeks on the "VIKING LEADER" and another had 4 years fishing experience and had just joined the vessel. The cook/deck-hand had 20 years sea-going experience of which 7 years were on the "VIKING LEADER".

Findings

The "VIKING LEADER" capsized in slight/moderate weather conditions off the west coast of Vancouver Island as a result of having insufficient transverse stability to withstand the dynamic heeling forces imposed upon her.

It would appear that the following factors contributed to the loss of transverse stability until the vessel capsized:

- the vessel sailed from Ucluelet with an excessive weight on deck (traps, warps and gear) which raised the vessel's vertical centre of gravity and reduced her freeboard;

- the reduced freeboard combined with the slight inherent list to starboard, allowed the shipping of water on deck at very small angles of heel again reducing the freeboard and causing free surface effects, and

- the reduction of transverse stability slowed down her rate of recovery and allowed more time for downflooding to progress until the vessel lost all positive stability.

Other Findings

Divergence from the designed hull form when the vessel was built led to the preparation of inaccurate trim and stability data, but this divergence did not initiate or propagate the extent of this casualty.

The "VIKING LEADER" did not carry a boat, dory or skiff and her liferaft was of insufficient capacity for all her crew members. She was therefore in contravention of the Small Fishing Vessel Inspection Regulations.

The response of the fishing vessel "ROYAL CANADIAN" was prompt and in accordance with the good practice of seamen.

OTTAWA, ONTARIO
APRIL 1987.

Glossary

EPIRB	Emergency Position Indicating Radio Beacon
GM	(Metacentric Height) is the distance between a vessel's transverse metacentre and her vertical centre of gravity and is a measure of her ability to right herself from small angles of heel.
Free Surface Effect	Whenever there is a surface of liquid which is free to move, there is a loss of effective GM due to a virtual rise of the vessel's centre of gravity.
Freeing Port	An opening in the bulwarks, sometimes with a hinged flap, to allow water shipped on deck to flow overboard.
GZ	(Righting Lever) is a measure of a vessel's ability to right herself over a range of heel angles, which, when multiplied by the vessel's displacement, indicates the righting moment.
Lazaret	The enclosed space at the stern of the vessel, often housing the steering gear.
'MAYDAY'	International Radio distress signal for calling urgent assistance.

ANNEX NO.1

Stability Evaluation

The "VIKING LEADER" was originally built and outfitted as a herring packer and longliner, and the necessary Steamship Inspection Certificate issued in 1973. In the first half of 1981, she was converted and outfitted for herring seining operations and at this time, permanent ballast was added. The ballast was comprised of approximately two tons of steel punching located in the port and starboard bilges of the engineroom, and two lengths of steel railway line which were welded to the underside of the vessel's keel. An inclining experiment was carried out July 9, 1981 and a Trim and Stability Booklet, incorporating four herring loading conditions submitted for approval January 8, 1982. The stability data, after the incorporation of additional information and a number of amendments, were finally approved by the Ship Safety Branch, March 21, 1984.

Submission of trim and stability data in accordance with the Small Fishing Vessel Inspection Regulations, Part 1, Section 29, is only required for vessels engaged in fishing for herring or capelin, and approval is based upon the vessel complying with the minimum criteria detailed in the Ship Safety Branch, 'Stability, Subdivision and Loadline Standards', Standard STAB 4. At the time of the casualty the "VIKING LEADER" was no longer engaged in fishing for herring, however, the criteria of STAB 4 are considered to be the most appropriate 'yardstick' against which the stability characteristics of small fishing vessels may be assessed.

In 1986, prior to the casualty, the seine winch, net and warps were removed and the vessel refitted with black cod trap fishing gear. During post-casualty inspections of the recovered vessel, the weights and locations of the outfit of black cod fishing gear were verified, and details of the cod traps, warps, bait, oil fuel and other consumables reportedly onboard at the time of the capsize were obtained from the skipper.

Measurement of the recovered vessel indicated that while the principal dimensions were satisfactory, the actual hull form differed significantly from the original designed lines, and that the forward and aft draught marks were not accurately located. No records have been found of why or how the modification of the designed hull form occurred while the vessel was being constructed. Because the 'as-built' and 'as-designed' hull forms were different, the original basic design data were no longer applicable, and therefore the stability characteristics submitted in the Trim and Stability Booklet did not represent the actual vessel. Approval of all stability data by Canadian Coast Guard is subject to the

accuracy of the basic design data submitted - this accuracy is the responsibility of the vessel's owner, his shipbuilder or naval architect.

The hull of the "VIKING LEADER" was measured in July, 1986, while she was hauled-out and being refitted after the casualty, and an 'as built' lines plan was prepared from which her actual hydrostatic particulars and cross curves of stability were derived. Toward the end of the refit, an inclining experiment was carried out July 18, 1986, and the vessel's current lightship weight and centre of gravity were verified.

A post-casualty analysis of the transverse stability characteristics of the "VIKING LEADER" was carried out which incorporated the currently established basic design data, and focused upon the detrimental effects of the additional weight, off-centre and vertical location of the black cod fishing gear, traps and warps, etc., together with the free-surface effect of the water reportedly shipped and retained on deck shortly before the capsize.

The intact stability loading condition incorporating the above and below deck deadweights and consumables reportedly on board shows that, upon departure, the transverse stability characteristics of the "VIKING LEADER" were substantially below the minimum standards of STAB 4. The maximum righting lever (GZ) of 0.11 m (0.35 ft) was only 50% of the minimum requirement, while the dynamic stability (area under the GZ curve) of 0.052 mR (9.73 ft°), was just 57% of the minimum requirement for angles of heel up to 40°.

Reportedly, on departure the "VIKING LEADER" had a slight list to starboard because of the off-centre location of the fixed black cod fishing gear, and post-casualty calculations show this to have been approximately 2.75°, with a corresponding freeboard of only 0.25 m (10 in.) In this loading condition even moderate rolling of approximately 5.25° in calm seas would cause water to be shipped onto the main deck. Because the effectiveness of the freeing ports in the port and starboard bulwarks was impaired as the deck edge became immersed at the end of each roll, the shipped water was not always completely cleared and, shortly before the capsize, was seen to have accumulated toward the after end of the main deck. As the quantity of water initially retained on deck was not great, a 'nominal' layer only 76 mm (3 in.) deep, 1.60 m (5.25 ft) long, and extending across the deck aft of the main hatchway, was incorporated in the post-casualty calculations and was considered to be a conservative representation of the vessel's actual condition.

The weight and free surface effect of the shipped water reduced the existing freeboard and caused a drastic deterioration of the vessel's already low stability characteristics. When the detrimental effects of the inherent heel caused by the off-centre black cod fishing gear are considered, the vessel's transverse stability deteriorates even further. In this latter condition, the maximum righting lever (GZ) of just 32 mm (1 1/4 in.) was reached at 15° heel, the total dynamic stability (area under the GZ curve) was only 0.011 mR (1.898 ft°) and the range of positive stability limited to 31.5°. These criteria represent the most likely condition immediately prior to the capsize and show that the maximum righting lever and total dynamic stability were only 15.6% and 11% respectively of the minimum standards required by STAB 4. Figure 1 graphically illustrates the relative levels of transverse dynamic stability of the vessel upon departure and shortly before the capsize, and compares them with the minimum standards of STAB 4.

It should be noted that these transverse stability characteristics are based upon the 'ideal' static sea state. In actual dynamic sea conditions, angles of roll are usually greater than calculated by 'static' methods, and because of the uneven effects of wave motion and ship speed, the calculated reserve dynamic stability of small vessels is subject to considerable fluctuation.

It would appear that while the "VIKING LEADER" was in the highly vulnerable condition indicated by the above characteristics, the dynamic heeling effect produced by the impetus of the vessel's rolling motion in the prevailing sea state overcame her initial ability to recover. Having been rolled toward the limiting range of positive stability, the vessel, because of the reduced righting levers, tended to remain heeled over to starboard for some time. When the angle of heel reached approximately 17° and the bulwark top rail became immersed, the sudden increase in the rate and quantity of water shipped and retained on the starboard side of the main deck retarded the vessel's recovery. The increasing angle of heel led to further water being shipped, and at this time the coaming of the door on the starboard side of the wheel-house was submerged. The subsequent downflooding into the forward compartments below the main deck effectively prevented the vessel's return to the upright, it continued until positive transverse stability was lost and the "VIKING LEADER" capsized.

The final momentum of the capsize was such that when the "VIKING LEADER" heeled toward and passed 90°, the two tons of unsecured steel punchings serving as permanent ballast were dislodged from the engine-room bilges, and the volume of air

entrapped in the engine-room and the other empty compartments was sufficient to ensure the vessel remained afloat. When the "VIKING LEADER" was completely capsized, the dislodged ballast, having fallen to the engine-room 'deckhead', contributed to the inverted initial statical stability, helped maintain the vessel in the inverted position, and facilitated her later recovery.

Annex 2 Regulatory requirements

The Small Fishing Vessel Inspection Regulations state in part:

PART I

FISHING VESSELS EXCEEDING 15 TONS, GROSS TONNAGE

Application

5. (1) Subject to subsections (2) and (3), this Part applies to every fishing vessel that

(*a*) exceeds 15 tons, gross tonnage, but does not exceed 150 tons, gross tonnage;

(*b*) does not exceed 24.4 m in length, and

(*c*) is not a sailing ship.

(3) Section 29 applies only to a fishing vessel of closed construction employed in catching herring or capelin where, on or after July 6, 1977,

(*a*) its keel was laid;

(*b*) it was registered as a Canadian ship;

(*c*) it was converted to herring or capelin fishing; or

(*d*) it underwent such modification that its stability characteristics were adversely affected.

Stability

29. (1) Subject to subsection (8), an inclining experiment shall be conducted in the presence of and to the satisfaction of an inspector in respect of every fishing vessel on completion or near completion of

(*a*) its construction;

(*b*) its registration as a Canadian ship,

(*c*) its conversion to herring or capelin fishing; or

(*d*) its modification as described in paragraph 5(3)(*d*)

(2) Subject to subsection (3), the results obtained from the inclining experiment referred to in subsection (1) in respect of a fishing vessel shall be developed to indicate the stability of the vessel under the following conditions:

(*a*) lightship;

(*b*) port departure;

(*c*) arrival at fishing grounds;

(*d*) half load;

(*e*) full load;

(*f*) worst operating condition affecting the stability;

Criteria

MARINE SAFETY BRANCH

STEAMSHIP INSPECTION SERVICE

STABILITY, SUBDIVISION AND LOAD LINE STANDARDS

The "General Notes" of which state in part:

> "The standards outlined in this booklet have been developed by the Board of Steamship Inspection, Department of Transport and indicate conditions of approval and criteria used by the approval authority in approving submissions required to be submitted by regulations written under the Canada Shipping Act."
>
> "The Criteria outlined in the various standards denote minimum requirements with no maximum limits having been set. The standards are intended to supplement the regulations in matters of detail to ensure uniform minimums across the country and give a base for shipowners, shipbuilders and designers to work from."

The appropriate Standard in relation to this report states in part:

STANDARD : STAB. 4

Stability Standard for Fishing Vessels which are:

(a) subject to compliance with the Large Fishing Vessel Inspection Regulations, or

(b) required to submit stability data by the Small Fishing Vessel Inspection Regulations.

The following minimum intact stability criteria are to be used in the approval of stability data for the above vessels.

(1) Operating conditions with no accumulated ice

(a) The area under the righting lever curve (GZ curve) should not be less than 0.055 metre-radians (10.34 feet degrees) up to $\theta = 30^{\circ}$ angle of heel and not less than 0.09 metre-radians (16.91 feet degrees) up to $\theta = 40^{\circ}$, or the angle or downflooding θ_f, if this angle is less than 40°.

Additionally, the area under the righting lever curve (GZ curve) between the angles of heel of 30° and 40° or between 30° and θ_f, if this angle is less than 40°, should not be less than 0.03 metre-radians (5.64 feet degrees).

(b) The righting lever GZ should be at least 0.20 metres (0.67 feet) at an angle of heel equal to or greater than 30°.

(c) The maximum righting arm should occur at an angle of heel preferably exceeding 30° but not less than 25°.

(d) The initial metacentric height GM_o should not be less than 0.35 metres (1.15 feet).

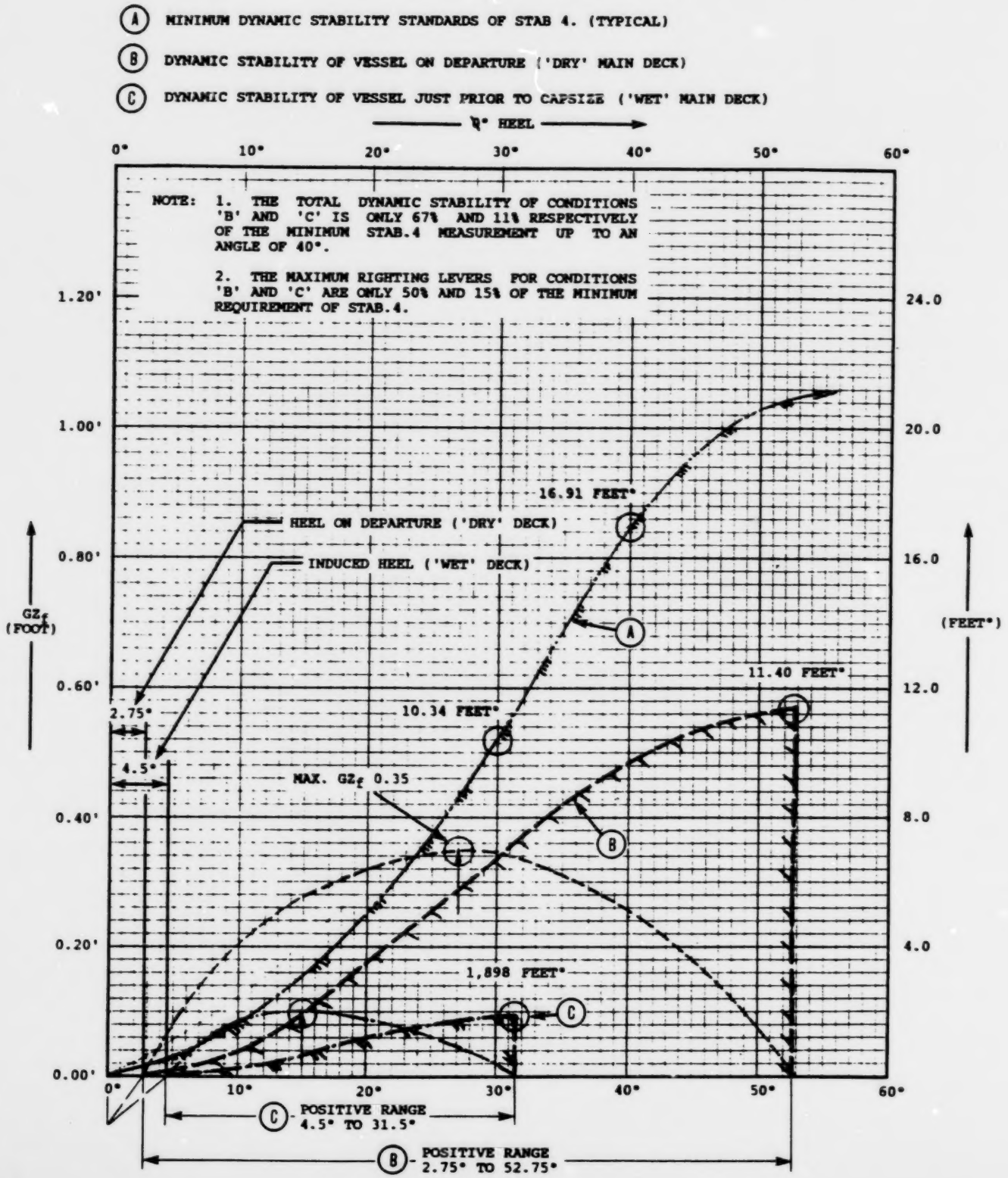
(3) Hydrostatic and stability curves should normally be prepared on a designed trim basis. However, where the operating trim or the form and arrangement of the ship are such that change in trim has an appreciable effect on righting arms, such change of trim is to be taken into account.

(7) In cases where a ship would flood through an opening, the stability curve is to be cut short at the corresponding angle of flooding and the ship is to be considered as having entirely lost her stability at that angle.

Note: Underlining in the above excerpts is for emphasis in relation to this report.

FIGURE No.1

F.V. "VIKING LEADER"


(A) MINIMUM DYNAMIC STABILITY STANDARDS OF STAB 4. (TYPICAL)
(B) DYNAMIC STABILITY OF VESSEL ON DEPARTURE ('DRY' MAIN DECK)
(C) DYNAMIC STABILITY OF VESSEL JUST PRIOR TO CAPSIZE ('WET' MAIN DECK)
θ° HEEL
NOTE: 1. THE TOTAL DYNAMIC STABILITY OF CONDITIONS 'B' AND 'C' IS ONLY 67% AND 11% RESPECTIVELY OF THE MINIMUM STAB.4 MEASUREMENT UP TO AN ANGLE OF 40°.
2. THE MAXIMUM RIGHTING LEVERS FOR CONDITIONS 'B' AND 'C' ARE ONLY 50% AND 15% OF THE MINIMUM REQUIREMENT OF STAB.4.
0° 10° 20° 30° 40° 50° 60°
1.20' 1.00' 0.80' 0.60' 0.40' 0.20' 0.00'
24.0 20.0 16.0 12.0 8.0 4.0
GZf (FOOT)
(FEET°)
16.91 FEET°
HEEL ON DEPARTURE ('DRY' DECK)
INDUCED HEEL ('WET' DECK)
11.40 FEET°
10.34 FEET°
2.75°
4.5°
MAX. GZf 0.35
1,898 FEET°
(C) POSITIVE RANGE 4.5° TO 31.5°
(B) POSITIVE RANGE 2.75° TO 52.75°

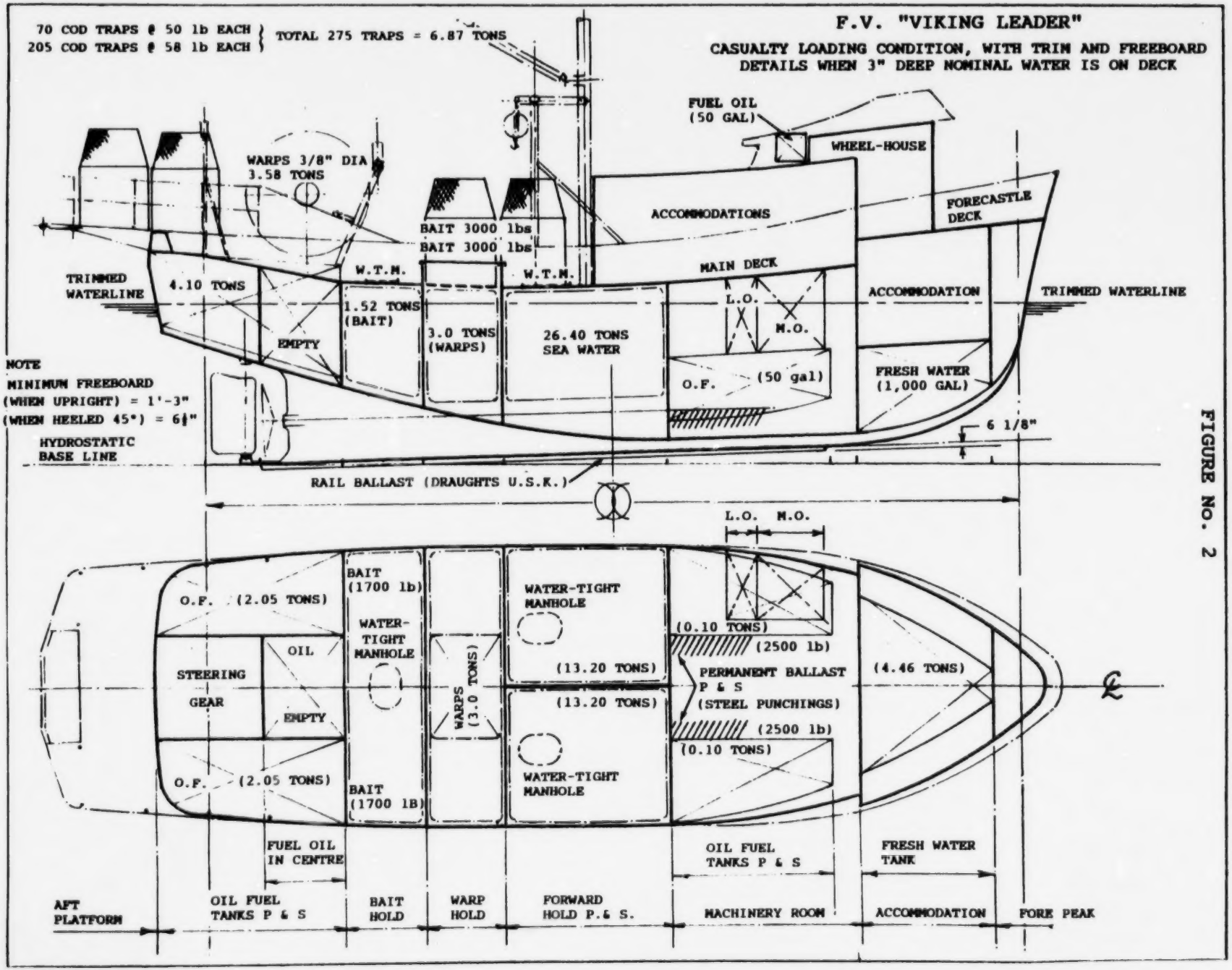
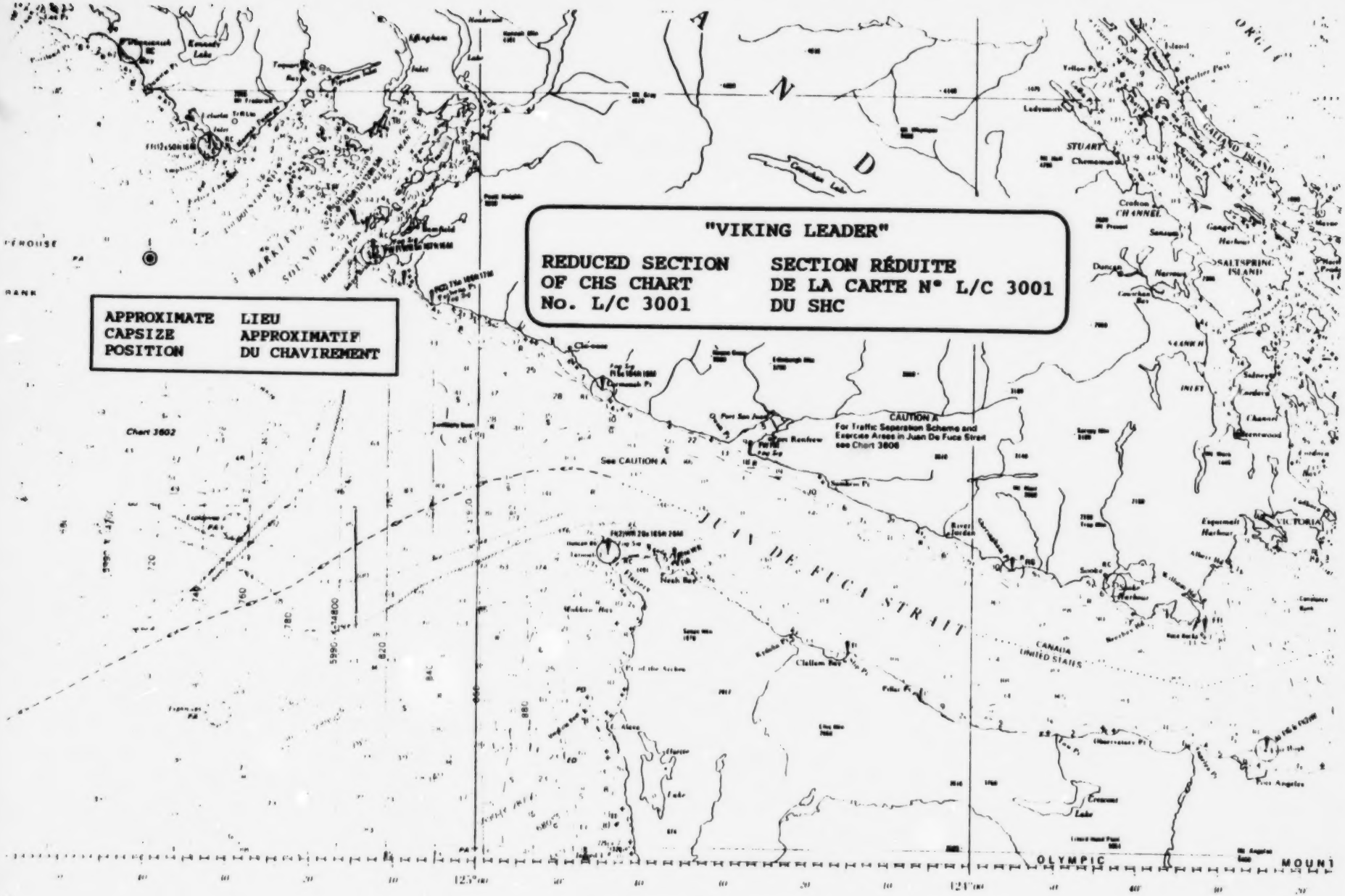
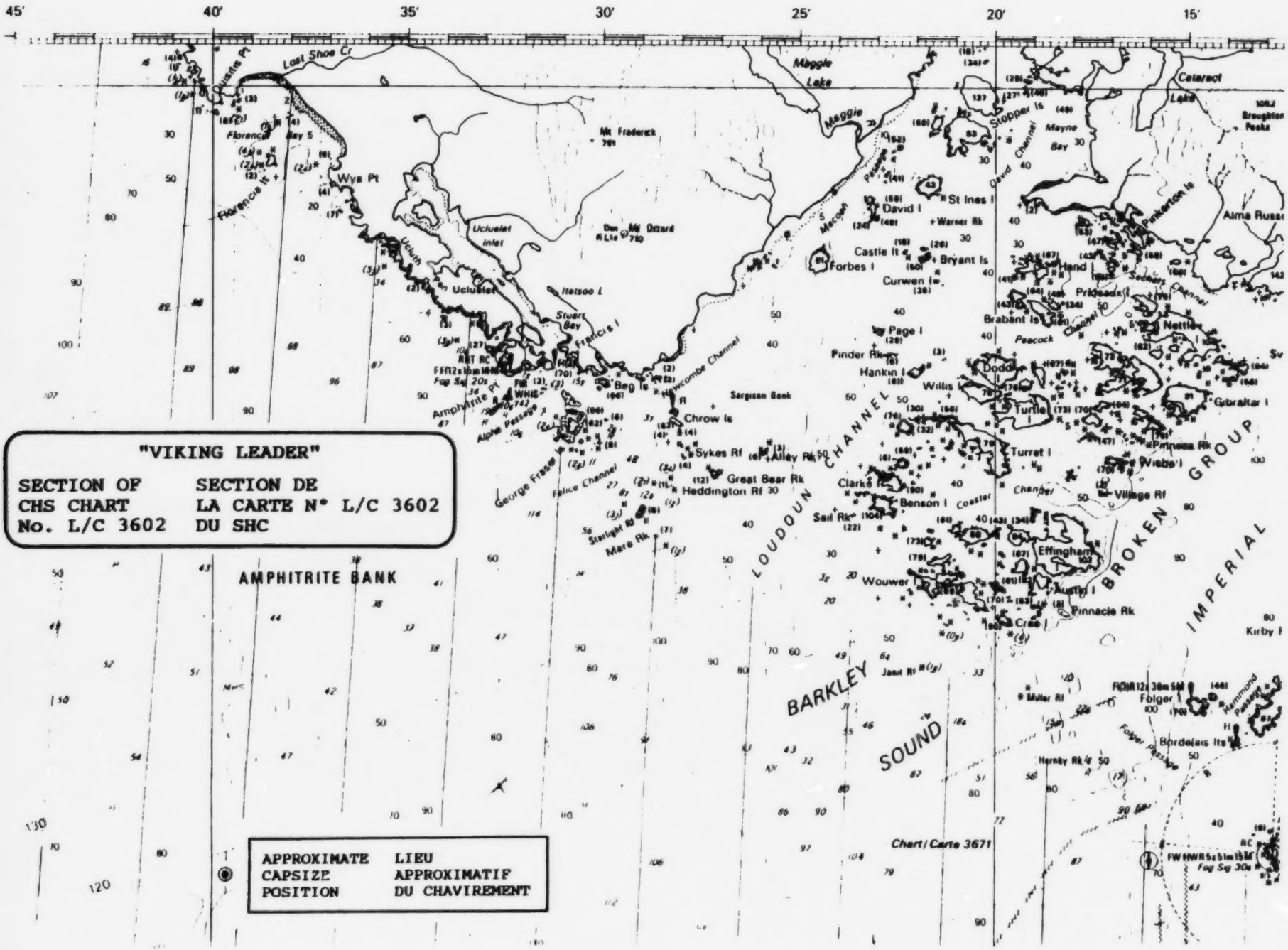
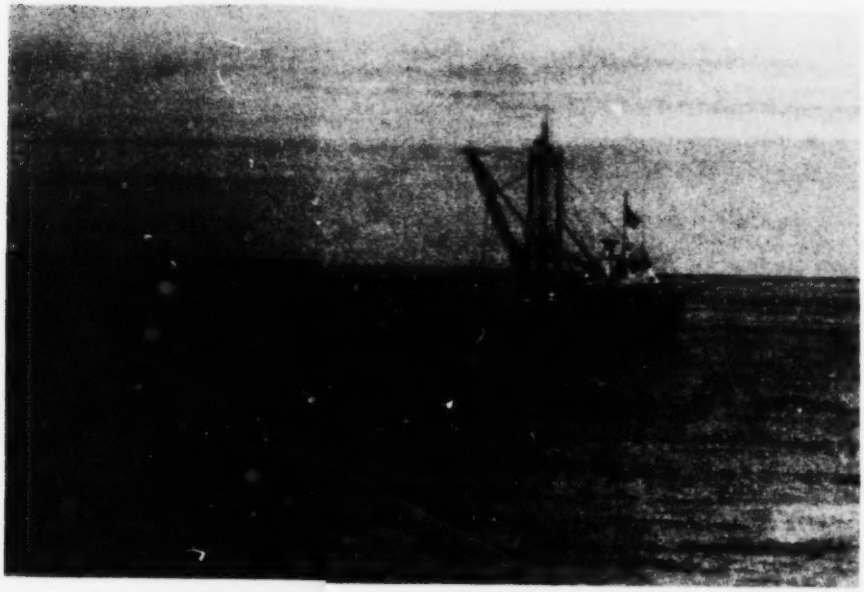

F.V. "VIKING LEADER"
CASUALTY LOADING CONDITION, WITH TRIM AND FREEBOARD DETAILS WHEN 3" DEEP NOMINAL WATER IS ON DECK
70 COD TRAPS @ 50 lb EACH
205 COD TRAPS @ 58 lb EACH
TOTAL 275 TRAPS = 6.87 TONS
FUEL OIL (50 GAL)
WHEEL-HOUSE
WARPS 3/8" DIA 3.58 TONS
ACCOMMODATIONS
FORECASTLE DECK
BAIT 3000 lbs
BAIT 3000 lbs
MAIN DECK
TRIMMED WATERLINE
W.T.M.
W.T.M.
4.10 TONS
1.52 TONS (BAIT)
3.0 TONS (WARPS)
26.40 TONS SEA WATER
L.O.
M.O.
ACCOMMODATION
TRIMMED WATERLINE
EMPTY
O.F. (50 gal)
FRESH WATER (1,000 GAL)
NOTE
MINIMUM FREEBOARD
(WHEN UPRIGHT) = 1'-3"
(WHEN HEELED 45°) = 6½"
6 1/8"
HYDROSTATIC BASE LINE
RAIL BALLAST (DRAUGHTS U.S.K.)
L.O. M.O.
O.F. (2.05 TONS)
BAIT (1700 lb)
WATER-TIGHT MANHOLE
WATER-TIGHT MANHOLE
(0.10 TONS)
(2500 lb)
OIL
STEERING GEAR
EMPTY
WARPS (3.0 TONS)
(13.20 TONS)
PERMANENT BALLAST P & S (STEEL PUNCHINGS)
(4.46 TONS)
(13.20 TONS)
(2500 lb)
(0.10 TONS)
O.F. (2.05 TONS)
BAIT (1700 lb)
WATER-TIGHT MANHOLE
FUEL OIL IN CENTRE
OIL FUEL TANKS P & S
FRESH WATER TANK
AFT PLATFORM
OIL FUEL TANKS P & S
BAIT HOLD
WARP HOLD
FORWARD HOLD P.& S.
MACHINERY ROOM
ACCOMMODATION
FORE PEAK

FIGURE No. 2


"VIKING LEADER"
REDUCED SECTION OF CHS CHART No. L/C 3001
SECTION RÉDUITE DE LA CARTE N° L/C 3001 DU SHC
APPROXIMATE CAPSIZE POSITION
LIEU APPROXIMATIF DU CHAVIREMENT
JUAN DE FUCA STRAIT
CAUTION A
For Traffic Separation Scheme and Exercise Areas in Juan De Fuca Strait see Chart 3606
See CAUTION A
Chart 3602
CANADA
UNITED STATES
OLYMPIC
STUART
SALTSPRING ISLAND
INLET


45'
40'
35'
30'
25'
20'
15'
"VIKING LEADER"
SECTION OF CHS CHART No. L/C 3602
SECTION DE LA CARTE N° L/C 3602 DU SHC
AMPHITRITE BANK
APPROXIMATE CAPSIZE POSITION
LIEU APPROXIMATIF DU CHAVIREMENT
Chart/Carte 3671
Lost Shoe Cr
Maggie Lake
Cataract Lake
Mt Frederick
Wya Pt
Florencia Bay
Uclulet Inlet
Uclulet
Itatsoo L
Stuart Bay
Francis I
Amphitrite Pt
Beg Is
Chrow Is
Sargison Bank
Sykes Rf
Alley Rk
Great Bear Rk
Heddington Rf
George Fraser Islet
Felice Channel
Starlight Rf
Mare Rk
Sail Rk
Clarke I
Benson I
Wouwer I
Cree I
Pinnacle Rk
Effingham
Austin I
Village Rf
Turret I
Turtle I
Dodd I
Willis I
Hankin I
Pinder Rk
Page I
Brabant Is
Peacock Channel
Nettle I
Gibraltar I
Princess Rk
Viaduct I
Curwen I
Forbes I
Castle It
Bryant Is
David I
Warner Rk
St Ines I
Stopper Is
Meyne Bay
David Channel
Parkerton Is
Alma Russ
Broughton Peaks
Hand
Prideaux I
Secheart Channel
Kirby I
Folger I
Bordelais Its
Hammond Passage
Folger Passage
Hornby Rk
Miller Rf
Jane Rf
LOUDOUN CHANNEL
BROKEN GROUP
IMPERIAL
BARKLEY SOUND



F/V "VIKING LEADER"

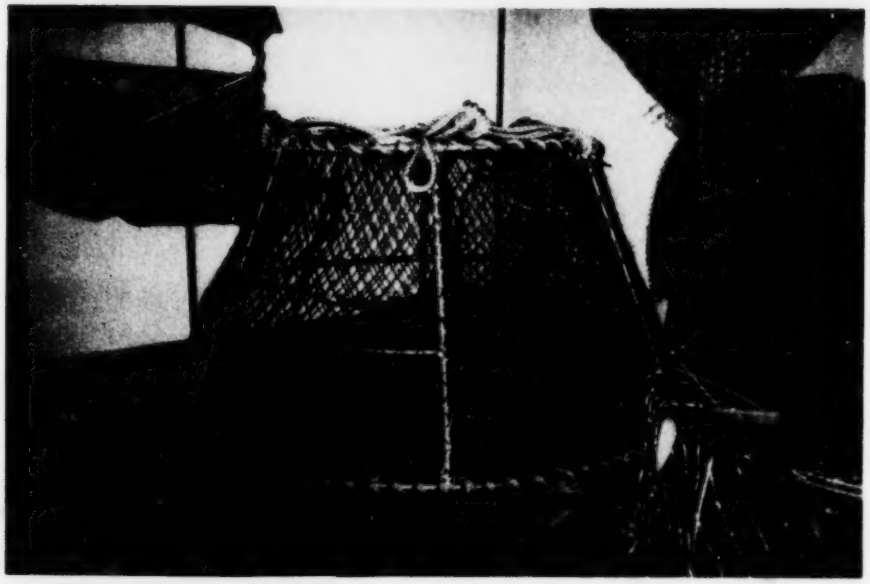
B.P."VIKING LEADER"

Before capsize.

Avant
le chavirement.

After recovery.

Après le
renflouement.

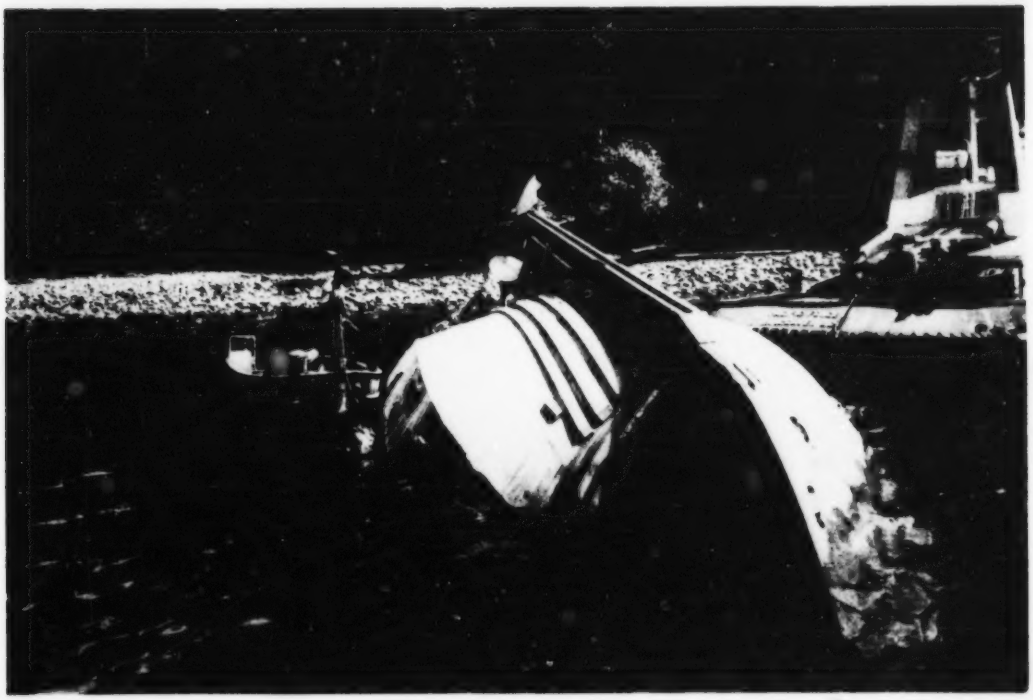


Black cod
fish trap.

Trappe à
morues noires.

F/V "VIKING LEADER"

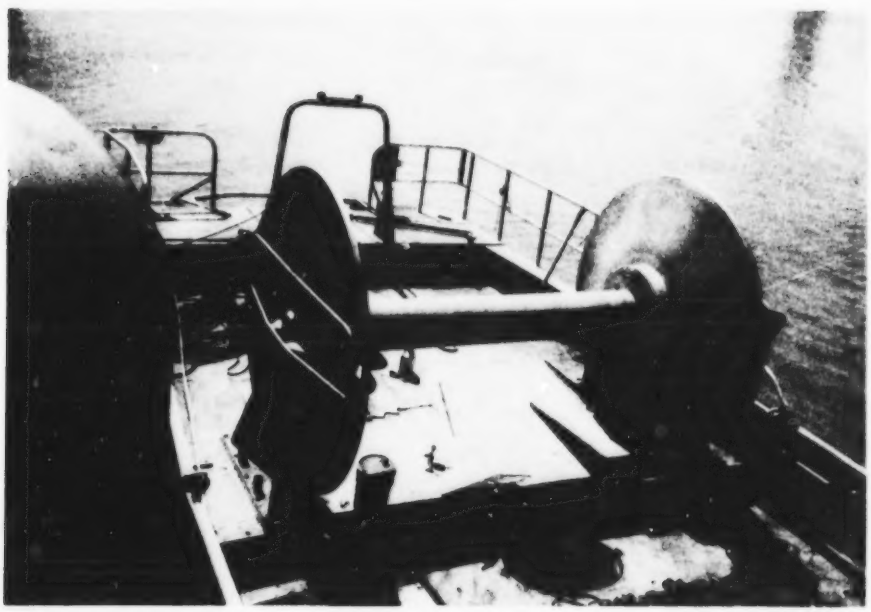
B.P. "VIKING LEADER"



Recovery operation. Opération de renflouement.

F/V "VIKING LEADER"

B.P. "VIKING LEADER"



Main deck aft. Pont principal arrière.